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OR GULLIES...



UAR 593 · UNIVERSITY OF ILLINOIS · COLLEGE OF AGRICULTURE
Extension Service in Agriculture and Home Economics

GRASS WATERWAYS . . .

are a necessary part of any sound farm plan for saving soil and water. Their wide, shallow, sod-lined channels safely dispose of surface water from heavy rains and thus keep it from forming gullies.

Wherever terraces are to be built, grass waterways will be needed. To give the grass time to form a good sod, these waterways should be put in at least a year before the terraces are built. They are also needed in nearly all fields farmed on the contour or strip-cropped.

Grass waterways are not hard to build, but a single seeding may not take hold well enough to withstand the effect of running water or unfavorable weather. Farmers replant other crops when they fail — the same persistence is needed with a grass waterway.

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For the cover illustrations and Figs. 1, 3, and 7 the authors are indebted to the U. S. Soil Conservation Service.

Urbana, Illinois October, 1945

Revised May, 1953

Cooperative Extension Work in Agriculture and Home Economics: University of Illinois, College of Agriculture, and the United States Department of Agriculture cooperating. Robert R. Hudelson, *Director*. Acts approved by Congress May 8 and June 30, 1914.

A-V Q.630.7
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GRASS OR GULLIES

E. D. Walker and R. C. Hay

PROTECTING NATURAL DRAINAGEWAYS from gullying is always a problem when sloping land is farmed. On many farms the channels that carry off excess rainfall are plowed and cultivated the same as the rest of the field. Some of the farmers who do this believe that keeping these natural drainageways "plowed shut" will prevent the formation of gullies too deep to cross. The fact is, however, that *plowing drainageways actually speeds the formation of gullies.* Furthermore, if this practice is continued for a number of years, much if not all of the surface soil for some distance on both sides of the drainageways will be plowed into them and washed away. Another harmful result of gullying is that tile located under the natural drainageways are often washed out and destroyed (*Fig. 1*).

Grass waterways are the answer to this problem of preventing gullies and protecting the tile. It must be remembered, however, that they do not take the place of soil treatment and

Left unprotected, the tile line on this Rock Island county farm has washed out. When it has been repaired, the gully should be worked in, shaped, and seeded to a permanent waterway. (Fig. 1)



erosion-control measures on adjoining slopes. Silt in a waterway is evidence that adjacent hillsides are eroding.

On some sloping fields erosion can be controlled by soil treatment and a rotation that includes plenty of soil-building grasses and legumes. On more sloping land, where the meadow mixtures in the rotation do not give enough protection, other measures are needed, such as contouring, contour strip-cropping, or terraces. Still steeper slopes are best kept in hay or pasture most of the time.

But no matter what other measures are used, the grass waterway is a valuable and necessary supporting practice.

LEAVE ESTABLISHED SOD

Fields that have been in hay or pasture often have good sod in the draws. This sod should be left undisturbed to form wide grass waterways (*Fig. 2*). Even a partial stand of grass should not be plowed—it is easier to thicken it with another seeding than to develop a new stand on bare soil.

Before plowing a field, mark the outside edges of draws with stakes or with shallow scratch furrows to indicate the part to be left in grass. The furrows will be obliterated as the

When this field in Woodford county was plowed out of alfalfa-bromegrass meadow, the owner was wise enough to leave the sod in the draw. With good care he will have an excellent waterway indefinitely. (Fig. 2)



field is plowed. Without marking, it is hard to see just where to throw out the plow.

Also when disking a field, it is important to avoid cutting up and destroying any sod that has become established in waterways. Turning between waterways is better than crossing them. Where crossing is necessary, always straighten disks.

PRELIMINARY STEPS

Provide a Wide Channel

One of the first things to consider in establishing a new grass waterway is the shape of the draw. The waterway should of course be wide enough and deep enough to carry off the water after the heaviest rain, and it should be shallow enough for mowing and crossing with farm machinery. A wide, almost flat-bottomed or saucer-shaped ditch, slightly deeper in the center than on the sides, is desirable (*Fig. 3, page 7*).

When a deep, narrow ditch has formed in part of a drainageway or a ditch has meandered badly (*Fig. 1*), the gully banks will need considerable shaping and straightening. If the ditch is small, regular tillage implements can be used. On larger gullies a grader or dozer is more effective. When shaping the ditch, use care to avoid leaving ridges and sharp turns that will interfere with mowing the grass on the waterway.

Waterways built according to the dimensions given in the table on page 6 should be safe for most Illinois cropland. It is a good practice to seed the banks to a line a little above the high-water mark of previous heavy rains. A small waterway can be made easier to mow by building it somewhat wider than would be needed to carry the actual runoff.

To use this table it is necessary to know the acreage to be drained and the slope of the ditch. It is also important to check the map and the note which accompany the table, and which indicate how the top width should be modified in different areas of the state. In area I, for example, a waterway draining 25 acres and having a slope of 3 feet in 100 (3 percent) should be 25 feet wide at the top and 8 inches deep. In

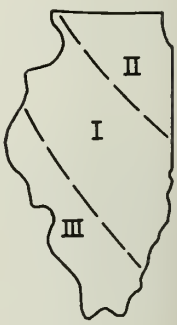
SUGGESTED DIMENSIONS FOR SOD WATERWAYS

For Normal Runoff With No Velocities Greater Than 5 Feet per Second[a]

Slope of channel		Acres drained by waterway													
		5	10	15	20	25	30	35	40	50	60	80	100	150	200
		Width and depth of channel													
0.5%	T *ft.*[b]	14	20	20	25	28	30	35	36	40	48	52	55	60	90
	D *in.*[b]	8	10	12	12	13	13	13	14	15	15	16	17	18	18
1%	T *ft.*	14	18	20	22	25	30	33	36	40	48	50	55	60	80
	D *in.*	8	9	10	11	11	11	11	11	12	12	14	12	17	17
2%	T *ft.*	14	18	19	22	25	28	32	36	40	45	50	55	60	70
	D *in.*	6	8	9	9	9	9	9	9	10	10	11	11	14	15
3%	T *ft.*	14	18	19	22	25	28	30	35	40	45	50	55	60	70
	D *in.*	6	6	8	8	8	8	9	9	9	9	10	11	12	12
4%	T *ft.*	14	18	19	20	25	28	30	35	40	45	50	55	70	
	D *in.*	5	6	8	8	8	8	8	8	8	8	9	10	10	
5%	T *ft.*	14	18	19	20	25	28	30	35	40	45	50	55		
	D *in.*	5	6	7	8	8	8	8	8	8	8	8	9		
6%	T *ft.*	14	18	19	20	25	28	30	35	40	45	55			
	D *in.*	5	5	6	7	7	7	7	7	8	8	8			
8%	T *ft.*	14	16	19	22	25	30	33	37	46	52				
	D *in.*	4	5	6	6	6	6	6	6	6	6				
10%	T *ft.*	14	16	20	25	30	35	38	43						
	D *in.*	4	5	5	5	5	5	5	5						

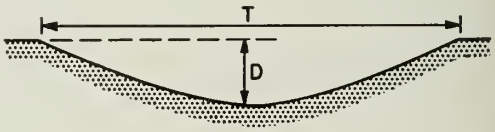
[a] Adapted from Soil Conservation Service Engineering Handbook for Region 3.

[b] T = Top width in feet. D = Depth in inches.



NOTE: The dimensions in this table apply specifically to that area indicated as "I" on the map. If you live in area II, *reduce* top widths by 2 feet. For area III, *increase* top widths by 2 feet.

Dimensions may also be modified according to the nature of the watershed. When watersheds are relatively flat or partly in pasture or woodland, slight reductions in depth of channels may be made. When watersheds are steep and cultivated, channels should be made wider than shown here. Be sure to consider the entire watershed, including land on other farms.



Cross-section of waterway showing how measurements are taken.

area II the top width should be 23 feet, and in area III it should be 27 feet. Having the proper dimensions is particularly important when the waterway is to serve as a terrace outlet.

Make Soil Conditions Favorable

Waterway seedings need a moist, fine, compact seedbed. Thoro working of the soil with disk and harrow is therefore important. Rolling the soil with a corrugated roller firms the seedbed and makes it less likely to wash before sod is formed. The roller is also an excellent tool for working the seed into the soil. The last tillage operation should, if possible, be made across the waterway.

To establish a resistant turf quickly, it is necessary that the soil have an abundance of easily available plant food. It is best to test the soil to find out if it needs limestone, phosphate, or potash.

A very good way to supply much of the needed fertility is to apply 8 to 10 tons of manure an acre and work it into the soil as the seedbed is prepared (*Fig. 3*). Manure, however, is relatively low in phosphorus, and on soils deficient in this element a phosphate fertilizer should also be used. Manure

The destructive ditch shown on the cover is being made into a grass waterway. The trees have been cut off and the banks shaped. The floor of the ditch has been broadened and carefully leveled. The soil has been worked into a fine, moist seedbed, and manure containing plenty of straw is being spread. See Fig. 4 for final results. (Fig. 3)



containing straw, disked into the soil, helps to prevent erosion until the grass starts growing. Or a mulch of strawy material, such as clover chaff or soybean straw, may be used to hold the soil and to help seedings "catch."

If no manure is available, ammonium nitrate should be applied at the rate of 100 to 150 pounds an acre, or an equivalent amount of other nitrogen fertilizers used. Or if tests show that phosphorus or potassium is lacking, a complete fertilizer high in nitrogen (such as 8-8-8 or 10-10-10) should be used at the rate of 400 to 800 pounds an acre. Plenty of fertility, especially nitrogen, is needed to give a waterway seeding a quick start toward development of a thick sod. On established waterways, fertilizer applications should be repeated as needed.

SEEDING THE WATERWAY

Best Time to Seed

Ordinary seeding methods, carefully used, are the cheapest means of establishing grass in draws that are bare of vegetation.

A waterway seeding may be made regardless of the crop on the watershed above. But since new seedings are always in danger of being washed out, it is best to make them when the field is in hay, pasture, or small grain. These close-growing crops help to hold back the runoff water, thus reducing the amount that must be carried in the waterway channel.

Draws which have shown only a slight to moderate tendency to gully may be seeded when the rest of the field is sown to meadow or pasture. Under these circumstances little special preparation may be needed.

Waterways should be seeded early in either spring or fall. Early fall is usually preferred in southern and central Illinois, while spring seeding is more common in the northern part of the state.

Fall seedings are not so likely to be washed out. The soil then is dry and will absorb more water, thus reducing runoff and erosion. Also weed growth is less serious. The cool, moist conditions of fall and early spring enable fall-seeded plants to

become better established before the weather becomes hot and dry. Many farmers, however, report success with spring seedings, so choice may depend on the most practical time to prepare the waterway.

What to Seed

A tough sod is needed for a waterway. Grasses are most desirable because of their extensive and fibrous root systems. The deep-rooted grasses — bromegrass, tall fescue, timothy, redtop, and reed canary grass — are best.

Bromegrass is a hardy, aggressive, sod-forming grass which is now the favorite in northern and central Illinois. When well established it gives good protection to a waterway channel. It does best on good soils but will grow well on poorer ones if they are well fertilized. Only southern strains are recommended for use in this state.

Tall fescue is a hardy grass which makes a good sod. It is the number one choice for general use in southern Illinois and for tight soils in other parts of the state. Tall fescue grows best on good soil but if well fertilized will do well on soils of low fertility and on tight soils which drain slowly. It starts quickly and makes a strong growth.

Timothy and redtop are two grasses well suited to waterway seedings in all parts of Illinois (*Fig. 4*). Redtop makes a good turf quickly and grows under a wide range of soil and climatic conditions. It does best on good soil and yet grows fairly well under drouthy conditions, on wet soils, or on soils low in fertility. Timothy, like redtop, is widely adapted, but requires somewhat better soil and does not grow as well on wet soil or during dry weather.

Reed canary grass is a long-lived perennial which produces an excellent growth, especially on wet areas. It is useful in waterways which stay wet and marshy during so much of the year that other grasses do not thrive. This kind of waterway has to be prepared and seeded when the soil is dry, usually in the summer. Reed canary grass can be seeded in the same way as other grasses. New seed should be used as old seed does not germinate well. Another method is to take root-



Here is the same area as shown in Fig. 3. For five years a vigorous growth of redtop and timothy has done its work well. (Fig. 4)

stocks from an established stand, chop them, spread them with a manure spreader, and then disk them into the soil.

Kentucky bluegrass grows best on fertile soils in central and northern Illinois, where it has been extensively used in waterways. It is not as deep-rooted as the other grasses already mentioned and therefore is not as desirable. Present practice is to omit bluegrass from the seeding mixture. On good soils it will often come naturally into stands of other grasses.

Nurse crop optional. Seedings made without a nurse crop are often completely satisfactory. However, a light seeding of a nurse crop will help to hold the soil until the grasses get well started. Spring grain seeded in the fall or fall grain seeded in the spring at the rate of ½ to 1 bushel an acre may be used for this purpose. Perennial ryegrass may be used in either season, but the seeding should be light (3 pounds an acre or less) to avoid smothering the other grasses.

Any nurse crop which threatens to compete seriously with the young grasses must be mowed and removed.

Legumes not essential. In a pasture or meadow mixture legumes are included for their ability to gather and supply nitrogen and thus increase the growth of the grasses, as well as for their value as feed. In a waterway, however, the grasses

must take hold quickly—there is not time to wait for nitrogen to be supplied by legumes. It is much more important to provide ample plant food at planting time by using manure or other fertilizer than it is to include legumes.

Legumes do not form a sod as do grasses but tend to loosen the soil and may winterkill, leaving bare spots. Once grasses are established, the moist condition in a waterway plus the fertility which tends to wash in from surrounding land will usually promote ample growth. If not, manure or other fertilizer should be used regularly.

Alsike clover will grow on wet soils and is therefore frequently included in seedings for waterways that tend to stay wet for considerable periods.

Use Plenty of Seed

A heavy seeding at a rate two to three times that for ordinary field conditions is necessary to establish a thick stand of plants quickly. The following suggestions are for an acre of waterway:

For the more-productive soils, well fertilized, especially in northern and central Illinois

Bromegrass 20 to 25 pounds

For use in the southern half of the state and thruout the state for tight soils which drain slowly

Tall fescue.....20 to 25 pounds

For general use thruout the state

Timothy.....6 to 8 pounds
Redtop.....4 to 6 pounds

For wet soils

Reed canary grass.....15 to 20 pounds

Temporary Seedings

Sometimes a temporary seeding is desirable in order to control erosion until permanent grasses can be established. Temporary seedings are recommended where spring seedings have failed or where seeding is to be delayed until fall.

Corn seeded at the rate of 3 to 4 bushels an acre in May or June will give good temporary protection. The seedlings grow rapidly and protect the soil from serious washing. In late August or early September the corn can be mowed and removed for forage. The regular waterway seeding can then be made in the stubble, which will prevent erosion until the young plants can get started. Care should be taken in making the permanent seeding to preserve the corn stubble to hold the soil until the new grasses take hold. This means that the channel should be shaped before the corn is seeded.

MAINTAINING A SOD WATERWAY

Give Waterway Regular Attention

A grass waterway can't be kept in good repair without regular attention. This is especially true if it carries a large volume of water or is on a steep slope. Sodding or reseeding small breaks in the sod, fastening down any loosened sod, and sloping back and sodding small overfalls are some of the ways to avoid having to make extensive repairs later. If the grass fails to make a good growth, manure or a fertilizer high in nitrogen should be applied.

A waterway should never be used as a road. The ruts or breaks that will be made in the sod will endanger the waterway. It is also important to control burrowing rodents such as ground hogs and moles.

Prevent Livestock Damage

If care is taken to protect waterways in rotation pastures, horses, cattle and sheep may be grazed on them at seasons when the ground is not soft. The animals, however, should not be allowed to cut paths lengthwise of the waterway. Short sections of fence built across the channel at intervals will help to prevent them from doing this. Electric fence may be used to keep animals out of waterways. Hogs should not be allowed in waterways as it is very difficult to prevent them from rooting the grass and making wallows.

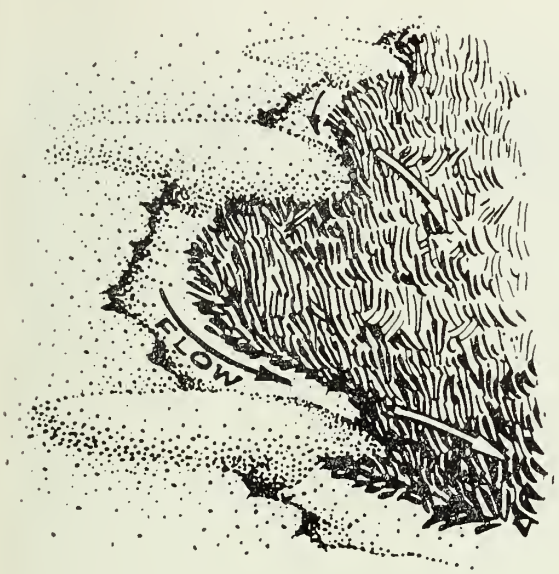
Gullies in permanent pastures will frequently heal over if livestock are fenced out. "Shingling" them with a light cov-

ering of brush is often just as effective as fencing if there are no hogs in the pasture. The shade which the grass receives from the brush encourages its growth. Care should be taken to remove debris and silt that may collect in the brush, smother the sod, and start scouring in the channel.

Control Silt

The silting in of the channel is a frequent reason for the failure of an established waterway. The water is forced to cut a new gully on one or both sides of the waterway. When much silting occurs, it means that serious erosion is taking place on the watershed and that more control measures are needed.

Many farmers use short diversion dikes or levees to stop ditches from forming at the side of a waterway and to keep the runoff water flowing over the sodded strip (*Fig. 5*). These short dikes can usually be built with a shovel or with a team and slip scraper. For longer dikes some type of grading equipment is more effective.



The gullies at the side of this waterway were formed when the channel was allowed to silt in. Short diversion dikes or levees will keep the runoff water flowing over the sodded strip, thus preventing the formation of ditches.
(Fig. 5)

When silting completely fills a waterway, it will be necessary either to widen the sodded area or to open a new channel of the desired size and re-establish the grass.

Use Care in Plowing

Plowing a field in which a grass waterway has been established requires special care. The plow must of course be lifted when the waterway is crossed. Since a plow moves forward several feet while the bottoms are being lifted, the lift must be tripped an ample distance from the edge of the waterway. The plow should be lifted along the edge of the waterway so as to stagger the furrows. Such slight staggering forms a jagged rather than a smooth edge, and by directing the flow of the water into the waterway tends to prevent the water from forming a channel at the side. In no case should an open furrow be left along the edge parallel to the waterway.

Mow Regularly

Heavy sod does not develop under the shade of a rank growth of weeds or of tall grass. Furthermore a heavy growth of vegetation retards the flow of the water and may cause it to spread beyond the grassed area. This tall vegetation may also



It is a good plan to mow for hay in June and then cut the grass as often as necessary the rest of the season. If the grass gets too heavy or too high it will block the free flow of the water. (Fig. 6)

be flattened out by the flowing water and, particularly if soil is deposited on top of it, may smother the grass.

A good practice is to cut the growth in the waterway for hay in June and then to mow it as often as necessary to keep the vegetation under control (*Fig. 6*). Some farmers harvest seed from their waterways. The clippings should be raked and removed to prevent drifts which smother the grass. If the grasses are allowed to mature seed occasionally, a stand can be maintained over a longer period.

AIDS IN ESTABLISHING WATERWAYS

Divert Runoff When Possible

Diverting the runoff from gullies by means of diversion ditches or terraces is often an important first step in establishing sod. This method is especially good for controlling hillside gullies that drain small watersheds. Frequently water draining into a gully can be diverted to another draw or another portion of the slope that is well sodded (*Fig. 7*).

When building diversion ditches, it is important to locate the ditch with a level, so as to avoid a fall of more than 6 inches per hundred feet. The ditch should be large enough to carry runoff water and should have a well-sodded outlet that will not be likely to erode severely. After diversion ditches

When terraces are constructed on this 7-percent slope, they will carry the water into one central drainageway. Terracing not only prevents gullies, but also reduces the number of waterways needed. (Fig. 7)



have been constructed, the gullies below them can be worked in and seeded with much less danger of washouts.

In some places, terraces may be so located as to run the water from several nearby waterways into one central drainageway. Thus only one or two waterways will be needed in an entire field where a much larger number were previously employed. Terraces must be carefully laid out with a surveyor's level and constructed properly for satisfactory performance. For guidance in building terraces see your farm adviser or soil conservationist.

When several waterways are needed on a field, it is usually best to start work on the smaller lateral waterways first and to leave large central ditches until they can be carefully studied.

The practice of filling gullies with rubbish is never to be recommended. Altho the original ditch may for a time appear to be controlled, eventually new ditches will cut out. Later, when a grass waterway is to be shaped and seeded, much hard work is required to remove the rubbish.

Use Tile Only for Underdrainage

Tile cannot be expected to replace open waterways for carrying away flood water. To carry any appreciable flood runoff, tile must be so large as to be very expensive. The use of surface inlets is of little help except to carry off small amounts of surface water after the flash runoff is past.

Tile are exceedingly useful, however, in removing excess soil water. Wet draws or adjacent areas often require tiling before satisfactory sod waterways can be established and the area conveniently farmed.

Tile lines placed under waterways often wash out and break. They usually must be repaired before a satisfactory grass waterway can be established. When a new tile line is to be laid along a waterway, laying it at the side of the waterway will reduce the danger of its being washed out.

Asphalt Can Help "Hold Everything"

Spraying the surface of a seeded and completed waterway with asphalt has proved effective in preventing erosion until

the seeding can get a start. Plants have no difficulty in coming through the asphalt "mulch." Since the black asphalt absorbs heat and helps hold moisture, seedings germinate quicker than without the asphalt covering. The use of asphalt is recommended where conditions make it difficult to establish a waterway seeding. See your farm adviser, conservationist, or vocational agriculture instructor for details regarding the kind of asphalt to use, amount needed, and method of applying.

Use Sod When Other Methods Fail

If the channel is well shaped and if other suggestions already made are followed, a good sod will generally develop without the use of other special measures.

Dams of straw, brush, stakes, and wire usually do more harm than good over a period of years and therefore are not recommended. They often create holes in the waterway just below the overfall. At best their average life is only a few years; then they must be replaced or erosion will start in the cuts around them.

Good sod cut from established stands of grasses such as reed canary grass, redtop, fescue, or bluegrass is excellent for covering areas where the seeding does not catch readily.

Sod flumes are especially useful at abrupt overfalls in a ditch and at gully heads. The overfall or gully head is sloped down to a gentle slope, extending horizontally 4 feet for each foot of height. Sod is then laid over and below the slope to form an apron (*Fig. 8*).

Sod flumes have been used successfully in overfalls as great as 8 to 10 feet when the area drained was comparatively small.

How to Make and Use a Sod Cutter

When considerable sodding is to be done, as in the construction of sod flumes, the work can be made easier by using a sod cutter. Two simple cutters are shown in Figs. 9 and 10. The sled cutter can be built by any farmer handy with tools, or by a local blacksmith, from materials which can be had in



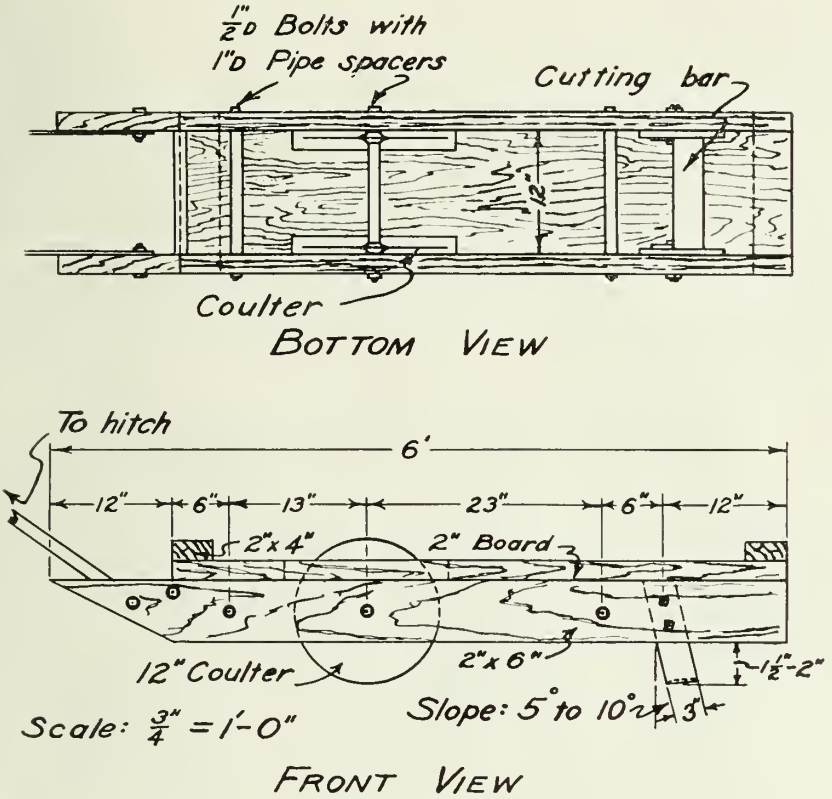
A sod flume is used at gully heads and overfalls. This one in Menard county was built as a demonstration during a conservation field day. The woven wire will hold the sod in place until the grass takes root, after which it will be removed. (Fig. 8)

most shops. Special care must be taken in adjusting the cutting blade and the rolling coulter. The sled cutter can be pulled with horses, a tractor, or a truck. The kicker type (*Fig. 10*) is available commercially.

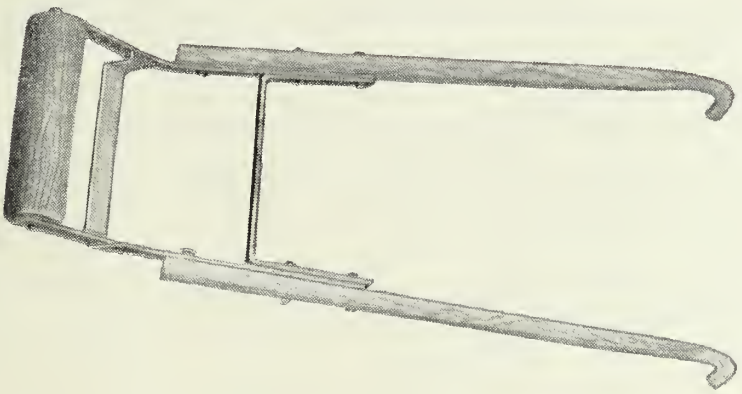
Sod should be cut from a level, well-sodded area, preferably of bluegrass, in strips 1 foot wide and 1½ to 2 inches thick. It may be transported on boards 6 to 10 feet long or it may be rolled. If a cutter is not available, a moldboard plow running shallow may be used. The sod may then be moved by turning it right side up on a short plank in sections of 6 to 8 feet.

Permanent Dams

To control larger gullies having high overfalls or large watersheds, some type of permanent soil-saving dam of earth, reinforced concrete, or masonry may be needed, usually at the



Any farmer handy with tools can make an inexpensive sled sod cutter. The one shown above can be drawn by horses, tractor, or truck. (Fig. 9)



This hand-operated sod cutter is available commercially. It is popular with farmers who are using sod for erosion control. (Fig. 10)

lower end of grass waterways. Since permanent dams are expensive to build and ones that wash out are worse than none at all, they must be built properly. Most landowners find it worth while to obtain the services of an agricultural engineer or soil conservationist to help locate, design, and supervise construction of permanent dams. Such services are available thru the office of the county farm adviser or the soil conservation district. Information can also be obtained from the Department of Agricultural Engineering, University of Illinois, Urbana.

Trees Sometimes Best for Gully Control

A gully at the lower end of a grass waterway can sometimes be stabilized more readily and at less cost with trees than by building a dam. In severe cases of gullying involving small watersheds, trees may be used to stabilize the greater part of the drainageway or drainage area.

In all sections of Illinois the black locust is considered the most satisfactory tree for this purpose. It grows rapidly and has an extensive root system which is valuable in checking erosion. The planting of locust should be made in the gully and a planting of some evergreen species should surround the gully, extending at least 2 rods from the rim to protect the gully banks. To avoid damage that will lessen the trees' value for erosion control, and also to satisfy distribution requirements of the state nurseries,[1] the entire area must be fenced to exclude livestock.

More detailed instructions for planting trees will be found in Circular 567, *Forest Planting on Illinois Farms,* which can be obtained from the College of Agriculture, University of Illinois, Urbana.

[1] Tree seedlings can be obtained at a nominal price from the Division of Forestry, Department of Conservation, Springfield, Illinois. Orders should be placed with the county farm adviser.

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